Wilder (B. G.)

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(*With five figures.*)

IT has been well remarked by Ecker (Edes, transl., 50[1]), that "the understanding of the convolutions of the occipital lobe is in itself more difficult than that of all the other lobes."

The present sources of this difficulty are five, relating respectively to: (A) the intrinsic features of the lobe itself; (B) the ordinary mode of removing the brain; (C) the way in which this region is commonly represented; (D) the prevalent belief that the human fissures may be elucidated by means of those of monkeys; (E) the custom of copying figures and accepting interpretations without critical comparison with large numbers of specimens.

To particularize somewhat:

(A) The dorso-caudo-lateral surface of the occipital region presents numerous small or secondary fissures, and even the principal ones are variable in certain respects; the whole

[1] See Bibliography at the close of this article.

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lobe has usually the appearance of being crowded into insufficient space.[1]

(B) During extraction of the brain by the ordinary method, the occipital lobe is apt to be cut with the saw, and more or less distorted or torn.

(C) As a whole the lobe is an irregular, three-sided pyramid. The base is the imaginary plane coinciding with the occipital fissure-plane; one of its sides, the mesal, is approximately flat, but the lateral and ventral are irregular, and the former, especially, changes direction constantly, and is, in fact, more caudal than either dorsal or lateral. Hence figures which represent the hemicerebrum in either of the four conventional positions, viz., from the lateral, mesal, dorsal, or ventral aspects, either exclude the group of occipital fissures and gyres altogether, or exhibit them foreshortened and indistinctly. To show them adequately in a photograph, the axis of the camera-tube should nearly coincide with the general direction of the occipital fissure, as in figs. 1 and 3. The case is similar with the frontal region.

(D) The nomenclature of the human occipital gyres (convolutions) introduced by Gratiolet in 1854 and largely followed, even up to the present time, was based, primarily, upon the condition of things in certain monkeys; yet, as Ecker says, in a continuation of the paragraph above quoted, in no part of the cerebral surface is the difference between the human brain and that of these monkeys more marked than in this very region.

(E) The reputation of Ecker, the clearness of his descriptions, and the simplicity of his figures, with the existence of both English and American translations, have caused his statements and views to be accepted, and his diagrams to be generally reproduced, not merely in compilations and clinical reports, but in the papers of original observers. But although, as I hope to show in a subsequent paper on the so-called "ape-fissure," Ecker has clearly explained

[1] May these characteristics be correlated with the fact that the occipital lobe is almost if not quite confined to the Primates, and is, so to speak, a "new thing" in Nature? The superficial smoothness of the monkey's lobe is only apparent, the poma ("operculum occipitale") really involving a very peculiar and considerable complication, which I hope to discuss in a future paper.

(pp. 56–60 and note) some of the distinctions between the human and the simian occipital lobe, yet his interpretation of the morphological relations of the parts immediately surrounding the dorsal end of the occipital fissure, which forms the natural starting-point for the study of this region, is not in accordance with what is indicated by the material examined by me, and not even, as it seems to me, substantiated by his own descriptions and figures.

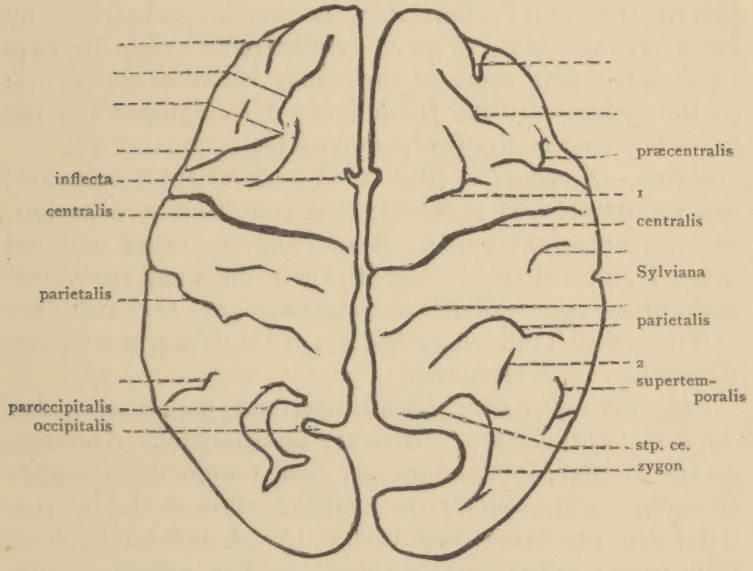

FIG. 1.—Dorso-caudal aspect of a fœtal human cerebrum; No. 734; x 1; drawn by Mrs. Gage.

Abbreviation.—The names designate fissures only, so the F. is omitted. *Zygon* and *stp. ce.* refer to parts of the paroccipital fissure (see fig. 2).

Main point.—The early condition of the paroccipital fissure as a U-shaped depression, opening toward the occipital, and deepest at its middle, with no evidence of a "transverse occipital" at its caudal end more than at its cephalic, and with no approach to the parietal. For the earliest stage see p. 308.

Preparation.—The entire body was injected through an umbilical artery, first with alcohol and then with starch-mass; (Gage, 19). The head was sawn through at the level of the mouth, and the cerebrum exposed, the base of the cranium being retained for the support of the brain.

Defects.—Unfortunately the size and weight of the fœtus were not recorded. The injection-mass was extravasated at several points, notably so as to distend the occipital fissure on the right side and the paroccipital on the left. The brain was not very well hardened, and the right hemicerebrum is apparently tilted somewhat caudad.

Secondary points.—(*a*) The lack of exact symmetry between most of the fissures of the two sides; (*b*) the interruption of the right parietal, (*c*) and of both precentrals.

Definitions.—The fissural and gyral names employed in this paper are, for the most part, the mononyms proposed by me a year ago (*66*); to avoid misconception they are here enumerated, with some of their more common synonyms; on the figures only the Latin forms are employed but the following are the English paronyms (see my paper *64*).

Gyres.—*Paroccipital* (Fig. 2, *G. paroccipitalis*) occipital; superoccipital; first occipital; first transition convolution; superior annectant gyrus. Respecting the other occipital gyres, I am in doubt as to both their limits and their most appropriate appellations. As stated in 1873 (*11*) and 1882 ("Anatomical Technology," p. 494) I think that the fissures should first be determined.

Fissures.—*Occipital;* occipito-parietal; parieto-occipital; internal perpendicular. *Parietal:* interparietal. *Supertemporal:* parallel; supra-temporal; first temporal. *Central:* Rolandic. *Paroccipital:* the caudal portion of the interparietal with the "transverse occipital." A few self-explanatory names occur on the figures. The following term requires special definition:

Zygal Fissures (*F. zygales*): H-shaped fissures, quadradiate fissures.—A general name proposed for fissures which, like the paroccipital, present a pair of branches at either end of a connecting bar or yoke (zygon). When the earliest condition of the fissure resembles a U, the rami constituting the sides of the U may be called *stipes*, and the others *rami*. To carry out the comparison with letters, the complete or typical condition of a zygal fissure is like two y's joined by their stems, Y, or, viewed from the side, like an expanded *H*,)—(. The orbital fissure often presents this arrangement (Ecker, Edes, transl., 33).

In Ecker's diagram of the dorsal aspect of the cerebrum (fig. 2) the right parietal ("interparietal") is made to stop nearly opposite the occipital, and there is a heavy line extending across the base of the lobe, a little caudad of the occipital, and wholly distinct from the parietal: this he calls the *sulcus occipitalis transversus.*

It is not necessary to include the figure in this paper, since the diagram has been reproduced substantially in the American translation of Ecker (Edes, transl., fig. 2, p. 19), and in the following commonly accessible works: Charcot (Fowler, transl., fig. 12, p. 53); Ferrier (fig. 65, p. 306); Huguenin (Keller and Duval, transl., fig. 37, p. 45).

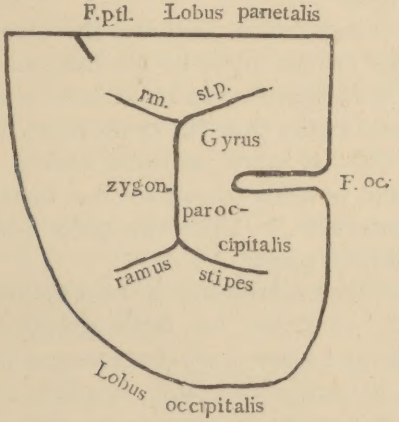

FIG. 2.—Diagram of the paroccipital fissure as a type of the zygal fissures.

FIG. 2.—The outline represents the dorsal (dorso-caudal) aspect of the occipital end of the left human hemicerebrum, including the occipital lobe and part of the parietal, with the dorsal end of the occipital fissure (*F. oc.*) and the caudal end of the parietal fissure (*F. ptl.*). The four-branched line represents the paroccipital fissure, bounding the paroccipital gyre (*Gyrus paroccipitalis*). Primitively, as in fig. 1, the figure is U-shaped, consisting of the occipital and parietal stems or stipes united by the longitudinal bar or zygon; the adult fissure usually presents, in addition, an occipital and parietal branch or ramus as in fig. 3. The parietal ramus often joins the parietal fissure, while the occipital ramus and stipe together constitute the "transverse occipital" fissure of Ecker and others.

Ecker's interpretation of the relations of the parietal and "transverse" fissures obviously depends upon the occasion-

al independence of the latter, and I was led to suppose that the small number of human brains accessible to me at the time of the publication of Ecker's work might be more or less anomalous in the occipital region. Recently, however, I have carefully examined all the brains in the Museum of Cornell University, twenty-nine occipital lobes, and all the original figures of the cerebrum in the best anatomical monographs and manuals. *In no case have I found even an approximation to an independent fissure* in the location of Ecker's "transverse"; on the contrary, in every specimen and in every figure, so far as I can judge,[1] a fissure there situated is joined by what Ecker regards as the extension of the "interparietal."

Since Ecker's reputation precludes the idea that the condition of things on the right of his diagram is altogether imaginary, or even based upon an artistic misconception, it may be supposed either that the brain there figured was exceptional, or, what is more probable, that a very different fissure, fœtal and possibly transitory, has been mistaken for the adult "transverse." Upon this point I hope to present evidence in another paper.

Whatever be the explanation of the difficulty, the "transverse occipital" of Ecker has been almost universally accepted. So far as I know, only three writers have expressed doubts as to its integrality and significance.[2] Clevenger (*21*) says that it "might be considered, and probably is, in many cases, a ramus projected forward [laterad] from the occipital termination of the parietal." Pansch holds (22) that the variability of the "*transversus*" excludes it from the category of primary fissures.

[1] The exquisite photographs in Dalton's recent work (vol. I. pl. 1, 2) represent the occipital region so much foreshortened that the relations of the fissures cannot be determined; the fissure named *transverse* on pl. 2. answers more nearly to Ecker's "occipitalis longitudinalis inferior" (his fig. 1, o ^{2}). On the left of pl. 1. the interpreting diagram omits what appears from the photograph to be a perfectly distinct continuation of the two divisions (caudal stipe and ramus) of what, according to Ecker, would be the "transverse."

[2] Edinger reproduces Ecker's diagram in two places (21, 22) with only a comment (23) upon the difficulty of recognizing the "regulation pattern" in the occipital region:

"Dieser Occipitallappen ist aussen nicht an allen Gehirnen so gleichmässig gefurcht, dass man immer die von den Autoren angegebene erste (obere), zweite (mittlere) und dritte (untere) occipitalwindung leicht und ohne Künstelei wieder finden könnte."

The most serious opposition to its acceptance is in the following passage from Wernicke's paper (321), which did not come into my hands until after my conclusions had been formed: "Das vorkommen einer durch besondere constanz oder tiefe ausgezeichneten queren Furche (*sulcus occipitalis transversus*) kann ich nach meinen Befunden am erwachsenen Gehirne nicht bestätigen."

There may be room for discussion respecting the propriety of accepting as an integer a fissure which, like the postsylvian of the cat and the postcentral of man, is only occasionally independent; but surely we are not called upon to accept without question the integrality of a supposed fissure which, like Ecker's "transverse occipital," is independent upon only one side of his own diagram, and which, apparently, no one else has ever found in that condition.

My first conclusion is, then, that *what is commonly understood as the transverse occipital of Ecker is not a fissural integer, and that the name and its synonyms should be abandoned.*

The second question is as to the relations of the longitudinal zygon (fig. 2) to the parietal. Ecker's view is indicated in all his figures and specifically stated in the following passages (pp. 58, 38):

> "In the fœtus the two portions of the fissure, the posterior (*occipitalis superior*) and anterior (*interparietalis*) [real parietal] arise separately from each other and subsequently unite. The former is nothing but an extension [*fortgesetst*, rendered *convolution* by obvious oversight in the American translation] of the latter."

On page 38, it is admitted that the fissure is less distinct ("manchmal weniger deutlich"), because often interrupted, and this more frequently on the right side. Nevertheless, on both sides of his diagram (fig. 2), the fissure is made continuous, and his view seems to have been generally accepted.

After a careful study of all the specimens and figures obtainable, I am led to conclude that this view is erroneous; that the true parietal and the "superior occipital" do not form parts of one fissure, and that the latter is the prin-

cipal and primary constituent — zygon — of a paroccipital fissure.

The evidence is threefold: (1) as admitted by Ecker, the zygon always appears independently in the fœtus; (2) as also admitted, it often remains separate in the adult; (3) when the union does occur, in all the cases examined with reference to this point, excepting one, the combined fissure is shallower at the presumed place of junction, and deeper at or near the middle of the two constituents— the true parietal and the paroccipital zygon.

In more detail, the facts are as follows:

1. The earliest trace of the paroccipital appears upon a fœtal cerebrum (No. 1820, M. C. U.), which, as preserved in alcohol, with slight distortion, measures 61 mm. in length. The central, Sylvian, occipital, and calcarine are well-marked; the parietal is a slight depression, directed obliquely. A more distinct longitudinal depression, perfectly distinct from the parietal and opposite the occipital, is undoubtedly the commencement of the paroccipital zygon. I regret that the age and size of the fœtus are not known.

The immediately succeeding stages have not been observed, but in fig. 1 and in Bischoff's paper (12, figs. 10, 12) the fissure presents itself as an irregular crescent, consisting of the zygon and the cephalic and caudal stipes, with traces of the corresponding rami.

2. As Ecker has frankly stated, the true parietal often remains separate from its supposed continuation upon the occipital lobe.

Among the 29 hemicerebrums, representing 25 individuals, in the museum of Cornell University, I find the separation complete in 13 and a junction in 16.[1] If to these be added the two shown in Bischoff's evidently accurate fig. 1, and the 12 carefully measured by Jensen, we have 43 cases, of which 22 are separate and 21 united.[2]

[1] So far as these cases go, there is striking confirmation of Ecker's remark, that the interruption appears to happen more often on the right side (p. 38). The fissures are independent on 9 right sides and only 4 left; the junction occurs on 10 left and 6 right. I neglected to note this point on Jensen's figures.

[2] It seemed best to exclude from this tabulation such of my specimens as are imperfect or poorly preserved so as to be doubtful, and also most published figures, which seldom represent the occipital region with distinctness.

So far then as reliable evidence is attainable by me at the present time, it appears that Ecker's "interparietal" is interrupted as often as it is continuous.

On page 38, Ecker endeavors to diminish the force of what would be commonly regarded as evidence adverse to his view, by affirming that the interruption of his "long" parietal occurs no more frequently than in, for example, the temporal fissures. Even if this be true, it is by no means certain that the temporal fissures are the integers they are ordinarily admitted to be; they certainly, like all other fissures, need monographic treatment.

It has been shown above that the caudal part of Ecker's interparietal is constantly connected with what he regards as a "transverse." In the majority of cases this transverse is not straight, but deflected caudad at both ends, so as to constitute a bifurcation of the zygon. In like manner, in most cases the cephalic end forks, one branch (stipe) extending meso-cephalad and remaining free, while the other (ramus), which extends latero-cephalad, often joins or is joined by the true parietal.

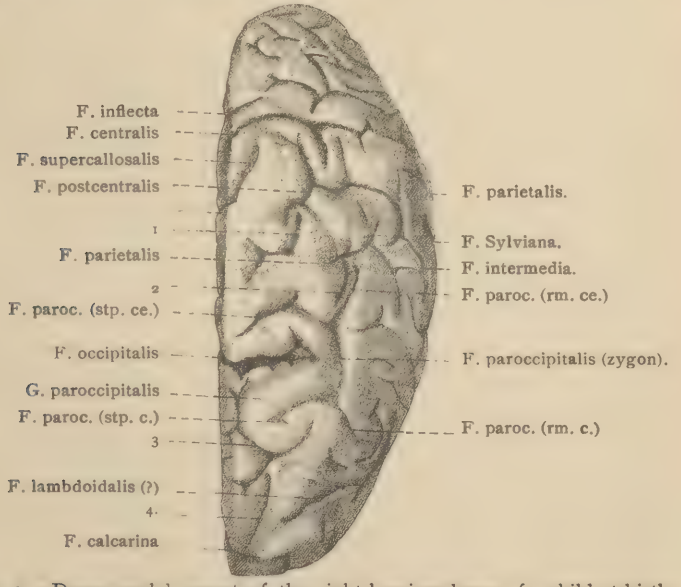

FIG. 3.—Dorso-caudal aspect of the right hemicerebrum of a child at birth, No. 478; x 1; drawn by Mrs. Gage.

Main point.—The relations of an independent paroccipital fissure to the occipital and parietal fissures. See diagram, fig. 2.

Abbreviations.—*F.*, fissure ; *G.*, gyrus ; *F., paroc.*, paroccipital fissure ; *stp. ce.*, *stp. c.*, the cephalic and caudal stipes of the paroccipital fissure ; *rm. ce.*, *rm. c.*, its cephalic and caudal rami. *1*, a separate fissure which may represent part of the postcentral ; *2*, a separate fissure, which probably represents part of the parietal, but which joins neither it nor the cephalic ramus of the paroccipital ; *3*, *4*, unidentified fissures.

Preparation.—The brain was hemisected while fresh, and the hemicerebrum hardened in alcohol while resting on the mesal surface ; hence it is thinner than it should be. It was photographed while supported so that the axis of the camera coincided nearly with the direction of the occipital fissure. The mesal surface is partly seen, much foreshortened.

Secondary points.—(*a*) The presence of the inflected fissure ; (*b*) the extension of the central fissure, so as to appear upon the meson ; (*c*) the extension of the supercallosal, so as to appear on the dorsum ; (*d*) the extension of the calcarine (dorsal fork), so as to appear not only upon the dorso-caudal aspect, but also in a lateral view of the brain (perhaps most of what shows is another fissure which is joined by the calcarine) ; (*e*) the presence of a fissure, independent of the occipital and paroccipital, which may be the one figured in the fœtus by Bischoff (figs. 7, 8, 9).

When the junction does not occur, the parts present more or less closely the appearance shown in fig. 3.

This simple, perfect condition of the paroccipital is represented on the right side of the orang's brain by Spurzheim (Pl. V.). In Bischoff's orang (fig. 26), the cephalic ramus is joined to the parietal.

If, as I believe, the zygon is the principal, central, and primary constituent of a fissural integer, the paroccipital, it would be expected to be deeper at or near its middle than at its ends, or than the stipes and rami. This is the case in the few brains which I have examined with reference to the point, and is exemplified in fig. 4, but numerous observations are desirable.

3. It is a generally accepted rule that a true fissural integer is usually deepest at or near the middle of its length, coinciding approximately with the place of its first appearance in the fœtus ; as a corollary, it is also generally believed that any marked or frequent shallowing in the course of a supposed integer furnishes ground for inquiry into the facts

of adult condition and development. It has already been seen that, so far as known, the true parietal and the paroccipital always commence independently, and the natural inference from this fact is further supported by what has been ascertained respecting the relative depth of the continuous fissure so formed.

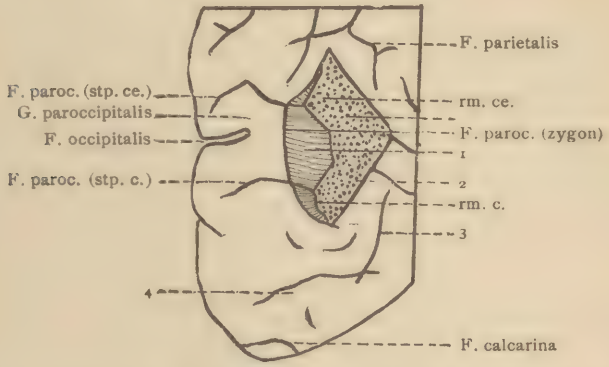

FIG. 4.—Diagram of the partly dissected paroccipital region of the right hemicerebrum (of a child at birth) represented in fig. 3; No. 478; x 1.

Main point.—The greater depth of the paroccipital fissure at the middle of the zygon than at its ends or in the rami.

Abbreviations.—*F. paroc.*, paroccipital fissure; *stp. ce.*, *stp. c*, its cephalic and caudal stipes; *rm. ce.*, *rm. c.*, its cephalic and caudal rami; 1, shaded with lines, the lateral surface of the paroccipital gyre; 2, shaded with dots, the cut surface left by removing the gyre just laterad of the paroccipital; *3*, *4*, unidentified fissures.

Preparation.—The preparation of the entire hemicerebrum is stated under fig. 3. For this figure the gyre immediately laterad of the paroccipital f. was removed by two incisions meeting at a point opposite the occipital. The preparation was photographed while tilted so as to show the lateral aspect of the paroccipital gyre more completely; hence the undulations of the dorsimesal outline.

In the few brains whose elasticity permitted the divarication of the gyres bordering the fissure in question, there appears to be a shallowing at or near the place of the presumed junction of the two fœtal fissures. With one right hemicerebrum (No. 376)—whose platetrope (fellow of the opposite side) by the way presented a total interruption, as in fig. 3—the lateral gyres were removed so as to expose the depth of the supposed single fissure throughout its en-

tire length. At the middle of the true parietal the depth is 12 mm., at the middle of the paroccipital zygon 16 mm., but at the middle of their combined length, where the depth should be greatest if it were a true integer, it is only 10 mm.

Facts of the same kind are supplied by the careful observations of Jensen, which are the more valuable in this connection, in that he was apparently inclined to regard the independence of the caudal division (my paroccipital) as abnormal. Jensen "sounded" the depth of the fissures of six brains. In the five hemicerebrums in which there was a continuity of the parietal and the paroccipital, his figures indicate a shallowing at the place of presumed junction.

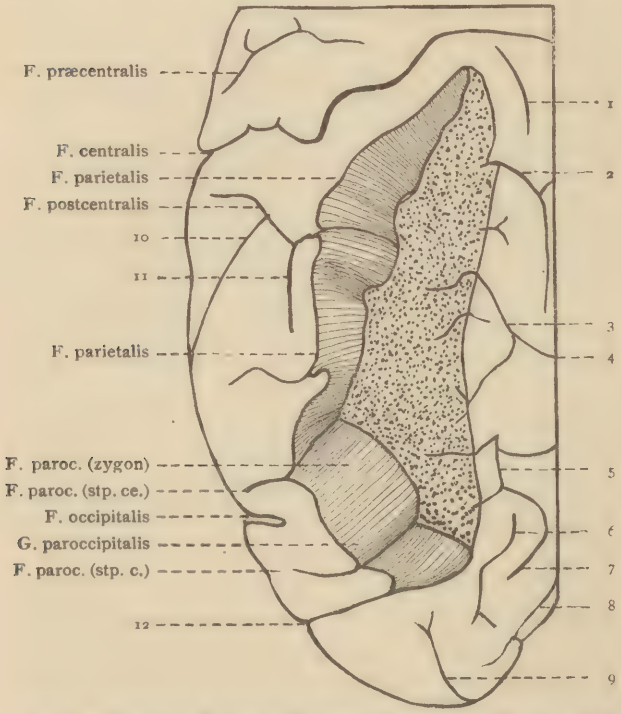

FIG. 5.—Diagram of the partly dissected paroccipital region of the right hemicerebrum of an adult man; No. 376; x 1.

Main point.—The shallowing of the parietal fissure at its junction with the paroccipital.

Abbreviations.—*F. paroc.*, paroccipital ; *stp. ce.*, *stp. c.*, its cephalic and caudal stipes ; *1*, a short, lunate fissure, which nearly joins the central ; *2*, (the line should join the short fissure which extends latero-cephalad) the Sylvian f.; *3*, *4*, extensions of the supertemporal f.; *5*, *6*, *7*, *8*, unidentified fissures ; *10*, *11*, caudal branches of the postcentral f.; *12*, an unidentified fissure which nearly reaches the dorsimesal margin of the hemicerebrum. As in fig. 4, the cut surface is indicated by dots, and the exposed sides of the gyres by vertical lines.

Preparation.—The gyres immediately laterad of the parietal and paroccipital fissures were removed by oblique incisions so as to expose the full depth of the fissures. The brain is a small one, weighing only 1115 grams when fresh, including the dura ; it was from an Irish hospital patient, thirty-seven years old.

Defects.—To avoid complication there has been omitted from the figure a fissure which extends latero-cephalad from the occipital ; on this and some other accounts the left hemicerebrum would have been preferable, but on that the paroccipital and parietal are wholly *independent.*

Finally, even Ecker himself, perhaps unintentionally, has narrowed at the same spot on fig. 2 the heavy line representing his continuous fissure.

The only difficulties encountered in recognizing the paroccipital fissure have arisen from the occasional presence of a more or less distinct transverse fissure between the occipital and one or the other ramus, so as to subdivide the cephalic or the caudal arm of the paroccipital gyre.

In these cases the gyre is wider than usual. Such intercalated fissures may be called *preparoccipital* and *postparoccipital.* I have not observed their co-existence on the same side.

SUMMARY.

Historical.—Most writers follow Ecker in recognizing a "transverse occipital fissure" and in regarding the parietal ("interparietal") as comprehending the whole length of a fissure which begins on the parietal lobe, may be interrupted in its course, but usually (*always*, I believe) joins the transverse nearly a right angle.

Facts.—1. In no figure accessible to me (excepting one side of Ecker's diagram), and in no one of twenty-nine adult occipital lobes examined, is there an independent fissure answering to the "transverse."

2. The supposed single parietal always begins in two parts: one, the true parietal, on the parietal lobe; the other, opposite the dorsal end of the occipital ("parieto-occipital") fissure.

3. In the adult these two fissures remain independent in about half of the cases, more often on the right side.

4. When there is a continuous fissure, it is, in all but one of the cases examined, shallower at the point where, if it were a single integer, it should be deepest.

Conclusions.—1. Ecker's "interparietal" includes (*a*) the true parietal; (*b*) the longitudinal part of a newly recognized fissural integer—the *paroccipital.*

2. In its typical condition, the paroccipital fissure is a longitudinal bar (zygon), opposite the occipital, bifurcating at each end into a cephalic and caudal stipe extending mesad, and a cephalic and caudal ramus extending laterad.

3. The "transverse occipital" of Ecker is the caudal stipe and ramus of the paroccipital, and does not constitute a fissural integer.

4. The paroccipital is an example of what may be called *zygal* or yoked fissures; the orbital is another.

5. The gyre intervening between the occipital fissure and the paroccipital may now be called the *paroccipital gyre*, instead of annectant convolution, etc.

6. Fissures which occur within the paroccipital gyre may be called, according to location, preparoccipital and post-paroccipital.

7. All fissures should be studied, not only in their development, their relation to other parts, and their superficial course and connections, but also in respect to their relative depth in various parts of their course.

8. The fissures of the dorso-caudal aspect of the occipital lobe are more clearly represented when the line of vision coincides nearly with the general direction of the occipital fissure.

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